REMARKS

The patent cited at page 3, line 37 of the present specification has been corrected to refer to US 5,253,913, consistent with the Crabbe et al U.S. Patent No. 5,352,912 supplied with the IDS, filed March 29, 2001.

Claim 3 has been rewritten in independent form.

Claims 1, 2, and 4-8 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa '614 in view of Admitted Prior Act.

The object of the present invention is to provide a heterobipolar transistor (HBT) having a base layer of a SiGeC ternary mixed crystal wherein the acceleration of carriers in the base layer is maximized and the degree of freedom of designing the herterobipolar transistor is improved.

In order to achieve the object, the present invention provides a compositional gradient of C in the base layer such that the C concentration increases from the interface facing the emitter layer to the interface facing the collector layer as set forth in claim 1.

Further, the present invention provides an HBT wherein only the C concentration level is increased from the first interface to the second interface, while maintaining the Ge concentration in the base layer substantially constant, as set forth in amended claim 3.

With regard to the HBT of FIGS. 1A and 1B, it has been known to form a compositional gradient of Ge in the SiGe binary base of an HBT.

Furukawa teaches the use of a SiGeC mixed crystal for the base layer of a heterobipolar transistor.

While it is noted that Furukawa certainly teaches various SiGeC compositions that achieve lattice matching to Si, the reference is silent about providing a C concentration gradient in the base layer of an HBT. Further, there is no teaching in Furukawa to increase the C concentration level from the first interface to the second interface.

Thus, the subject matter of the present invention is not derived even when Admitted Art is combined with Furukawa.

Claims 1, 2 and 4-11 stand rejected under 35 USC §103(a) as being unpatentable over JP '834 in view of Furukawa '614.

JP '834 describes a SiGeC ternary base with compositional gradient for C and Ge, wherein it is noted that the compositional gradient of C in JP '834 is just opposite to the compositional gradient of the present invention as set forth in claim 1.

Thus, the subject mater of claim 1 is not derived even when JP '834 is combined with Furukawa.

Claim 3 has been amended to be in independent form.

Thus, claim 3 describes a feature of the SiGeC base layer containing a substantially constant Ge concentration level and the C concentration level is increased from the first interface to the second interface.

According to such a construction, too, there is formed a slope in the conduction band in correspondence to the base layer, and the electrons undergo acceleration by the drift electric field as they flow through the base layer from the emitter layer to the collector layer. By holding the concentration level of Ge in the base layer constant, it becomes possible to avoid the situation in

which a large amount of C has to be incorporated into the part of the base layer where the Ge concentration level is increased.

Thus, the construction as set forth in amended claim 3 is advantageous for introducing a large amount of C into the SiGeC base and to form a steep gradient of the conduction band in the base layer.

It is believed that this feature is not disclosed or suggested in any of the references.

The embodiments of the present claims 10 and 11 are particularly non-obvious. There is no suggestion in US 4,885,614 or JP 834, whether viewed singly or in combination, of including carbon in any region of the emitter layer or the collector layer. The "related art" cited by the Examiner, also does not suggest including carbon in any region of the emitter layer or the collector layer.

Accordingly, the rejections under 35 USC 103 should be withdrawn.

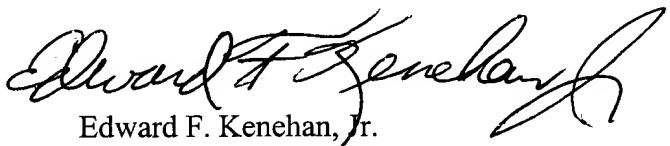
Since generic claim 1 is allowable, claims 3, 12 and 13 should now be considered, as indicated in the paragraph bridging pages 2 and 3 of the Official Action, mailed April 1, 2002.

Allowance is requested.

In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN, HATTORI, LLP



Edward F. Kenehan, Jr.
Attorney for Applicant
Reg. No. 28,962

Atty. Docket No. 010401
Suite 1000
1725 K Street, N.W.
Washington, D.C. 20006
Tel: (202) 659-2930
EFK/lj
Attachments: Version with markings to show changes made
Q:\HOME\jli\EdwardKenehan\01\010401 amendment.frm

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the specification

Paragraph beginning at line 21 of page 3 has been amended as follows:

As represented in the band structure of FIG.1B, the base layer 13 contains Ge with a concentration profile such that the Ge concentration increases from the interface between the base layer 13 and the emitter layer 14 to the interface between the base layer 13 and the collector layer 12, and there occurs a gradient in the conduction band Ec in the base layer 13 in such a manner that the conduction band Ec is inclined toward the collector layer 12. By providing such a graded compositional profile in the base layer 13, it becomes possible to accelerate the electrons causing a diffusion in the base layer 13 by applying thereto a drift electric field. Thereby, the operational speed of the heterobipolar 10 is improved. About the heterobipolar transistor using such a SiGe binary mixed crystal, reference should be made to the United States Patent [5,353,912] 5,352,912.

In the claims:

Please amend claim 3 as follows:

3. (Amended) A heterobipolar transistor, comprising:

a substrate;

a collector layer formed on said substrate;

a base layer formed on said collector layer; and

an emitter layer formed on said base layer,

said base layer comprising a SiGeC ternary mixed crystal having a C concentration profile such that a C concentration in said base layer increases from a first interface facing said emitter layer to a second interface facing said collector layer,

[A heterobipolar transistor as claimed in claim 1,]

wherein said base layer has a Ge concentration substantially constant from said first interface to said second interface.